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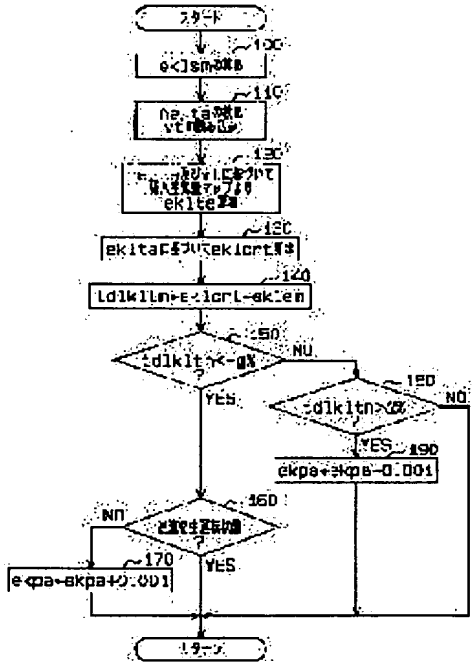
(54) ATMOSPHERIC PRESSURE LEARNING DEVICE FOR INTERNAL COMBUSTION ENGINE

(57)Abstract:
PROBLEM TO BE SOLVED: To provide an atmospheric pressure learning device for an internal combustion engine capable of accurately performing atmospheric pressure learning even at the change of an engine operating state.
SOLUTION: The actual intake air quantity eklsm of an intake passage is detected. On the basis of engine speed ne, throttle opening ta and valve timing vt, a basic intake air quantity eklta is computed referring to an intake air quantity map. The reference intake air quantity eklcrt, considering the change of an engine operating state, is computed on the basis of the basic intake air quantity eklta. When the difference tdlkltn obtained by subtracting the actual intake air quantity eklsm from the reference intake air quantity eklcrt is less than $-\alpha$% and the operating state is not in a back flow generating operating state, a prescribed value is added to the present atmospheric pressure correction value to update the atmospheric pressure correction value ekpa. When the difference tdlkltn is larger than α%, the prescribed value is subtracted from the present atmospheric pressure correction value to update the atmospheric pressure correction value ekpa.



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CLAIMS

[Claim(s)]
[Claim 1] The air flow meter which measures the real inhalation air content which passes through an internal combustion engine's inhalation-of-air path, While computing the basic inhalation air content in criteria atmospheric pressure based on the engine operational status containing the opening and engine rotational speed of a throttle valve which were prepared in said inhalation-of-air path Atmospheric pressure study equipment of the internal combustion engine characterized by having a study means to perform atmospheric pressure study by measuring a calculation means to compute the criteria inhalation air content which took into consideration change of said engine operational status based on the basic inhalation air content, and said criteria inhalation air content and said real inhalation air content.
[Claim 2] The air flow meter which measures the real inhalation air content which passes through an internal combustion engine's inhalation-of-air path, A calculation means to compute a criteria inhalation air content based on the basic inhalation air content in the criteria atmospheric pressure computed according to the engine operational status containing the opening and engine rotational speed of a throttle valve which were prepared in said inhalation-of-air path, A judgment means by which said engine operational status judges whether it is the back flow generating operational status which the back flow of inhalation air generates, A study means to perform atmospheric pressure study by measuring said criteria inhalation air content and said real inhalation air content, and when it is judged with said engine operational status being back flow generating operational status, Atmospheric pressure study equipment of the internal combustion engine characterized by having a prohibition means to forbid the renewal of an increment of the atmospheric pressure correction value by said study means when there are more said real inhalation air contents than said criteria inhalation air content.
[Claim 3] The air flow meter which measures the real inhalation air content which passes through an internal combustion engine's inhalation-of-air path, A calculation means to compute a criteria inhalation air content based on the basic inhalation air content in the criteria atmospheric pressure computed according to the engine operational status containing the opening and engine rotational speed of a throttle valve which were prepared in said inhalation-of-air path, In the atmospheric pressure study equipment of the internal combustion engine having a study means to perform atmospheric pressure study by measuring said criteria inhalation air content and said real inhalation air content said calculation means It has a storage means to memorize the air content data set up in the real inhalation air content measured with said air flow meter in the engine operational status of arbitration with said criteria atmospheric pressure. Said calculation means is atmospheric pressure study equipment of the internal combustion engine characterized by computing said basic inhalation air content with reference to said air content data based on the engine operational status at that time.
[Claim 4] It is atmospheric pressure study equipment of the internal combustion engine characterized by computing the criteria inhalation air content as which said calculation means considered change of said engine operational status based on said basic inhalation air content in the atmospheric pressure study equipment of an internal combustion engine given in either claim 2 and claim 3.
[Claim 5] Said study means is atmospheric pressure study equipment of the internal combustion engine characterized by performing atmospheric pressure study when the difference of said criteria inhalation air content and said real inhalation air content is beyond a predetermined value in the atmospheric pressure study equipment of an internal combustion engine according to claim 1 to 4.

[Translation done.]

* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the atmospheric pressure study equipment of the internal combustion engine which learns atmospheric pressure based on an internal combustion engine's inhalation air content ratio, without using an atmospheric pressure sensor.
[0002]
[Description of the Prior Art] What calculated the amount of atmospheric-pressure study amendments used for fuel-injection control (Air Fuel Ratio Control) of an engine with the cheap configuration, without using an atmospheric-pressure sensor in recent years is indicated in JP,6-81914,B. This thing calculates the inhalation air content in the criteria atmospheric pressure according to the engine operational status at that time using the inhalation air content map in the criteria atmospheric pressure set up according to the engine operational status containing an engine speed and throttle opening. And he is trying to calculate atmospheric pressure correction value by measuring the inhalation air content in this criteria atmospheric pressure, and the inhalation air content actually measured with the air flow meter.
[0003] By the way, if it is influenced by the engine of inhalation-of-air pulsation and throttle opening becomes large, inhalation-of-air pulsation will become large in an engine low rotational-speed field, and the back flow of inhalation air will produce the flow of the inhalation air in an inhalation-of-air path in an inhalation-of-air path under the effect. If such a back flow arises, since an air flow meter also measures the air content which flowed backwards on a principle, it will measure an air content excessively to the actually inhaled air content. For this reason, in the engine operational status which a back flow generates, a part for the error by back flow will be contained in the inhalation air content measured with the air flow meter, and exact atmospheric pressure correction value cannot be computed. In order to eliminate a part for the error by such back flow, in case atmospheric pressure correction value is calculated, the maximum inhalation air content in criteria atmospheric pressure is calculated, and the real inhalation air content measured with the air flow meter is restricted to below an upper limit guard value by making this maximum inhalation air content into an upper limit guard value.
[0004] Moreover, the above-mentioned inhalation air content map is set up based on the real inhalation air content fundamentally measured with the air flow meter in the stable state of throttle opening and an engine speed in the criteria atmospheric pressure. In addition, in the engine operational status which a back flow generates, the value which took into consideration the correction value in Air Fuel Ratio Control to the above-mentioned upper limit guard value is set up.
[0005]
[Problem(s) to be Solved by the Invention] Therefore, with a technique given [above-mentioned] in an official report, since there is no effect of the delay of inhalation air in a real inhalation air content when engine operational status is stable at the time of measurement of a real inhalation air content, the difference of a criteria inhalation air content and a real inhalation air content is based on an atmospheric pressure difference. Therefore, atmospheric pressure study can be performed with a sufficient precision by measuring a criteria inhalation air content and a real inhalation air content in the stable state of engine operational status.
[0006] However, in order inhalation air is overdue to change of engine operational status at the time of change of the engine operational status from which throttle opening changes or an engine speed changes and to change, the effect by delay is included in a real inhalation air content. Therefore, the difference of the criteria inhalation air content and real inhalation air content based on the engine operational status at that time cannot become what included the effect by the delay of inhalation air in addition to the atmospheric

pressure difference, and cannot compute exact atmospheric pressure correction value, but has the problem of incorrect-learning.

[0007] Moreover, in the engine operational status which a back flow generates, if the real inhalation air content measured with the air flow meter becomes a big value, a real inhalation air content will be restricted to an upper limit guard value. However, in the engine operational status which a back flow generates, since the value in consideration of the correction value of Air Fuel Ratio Control is set to the criteria inhalation air content which referred to the above-mentioned inhalation air content map, the restricted real inhalation air content may become a bigger value than a criteria inhalation air content. In this case, there is a problem of incorrect-learning in the direction which increases atmospheric pressure correction value.

[0008] This invention is made in view of such the actual condition, and the purpose is in offering the atmospheric pressure study equipment of the internal combustion engine which can perform atmospheric pressure study with a sufficient precision at the time of change of engine operational status.

[0009] Another purpose of this invention is to offer the atmospheric pressure study equipment of the internal combustion engine which can prevent incorrect study of the atmospheric pressure study in the back flow generating operational status which the back flow of inhalation air generates.

[0010] Another purpose of this invention is to offer the atmospheric pressure study equipment of the internal combustion engine which can perform atmospheric pressure study with a sufficient precision also in the back flow generating operational status which the back flow of inhalation air generates.

[0011]

[Means for Solving the Problem] Hereafter, the means and its operation effectiveness for attaining the above-mentioned purpose are indicated. The air flow meter which measures the real inhalation air content to which invention according to claim 1 passes through an internal combustion engine's inhalation-of-air path, While computing the basic inhalation air content in criteria atmospheric pressure based on the engine operational status containing the opening and engine rotational speed of a throttle valve which were prepared in said inhalation-of-air path It is characterized by having a study means to perform atmospheric pressure study by measuring a calculation means to compute the criteria inhalation air content which took into consideration change of said engine operational status based on the basic inhalation air content, and said criteria inhalation air content and said real inhalation air content.

[0012] According to the configuration of claim 1, by the stable state of engine operational status, the basic inhalation air content is stable and a basic inhalation air content turns into a criteria inhalation air content. Therefore, the difference of the criteria inhalation air content and real inhalation air content which are computed based on engine operational status is based on an atmospheric pressure difference. Therefore, atmospheric pressure study can be performed with a sufficient precision by measuring a criteria inhalation air content and a real inhalation air content in the stable state of engine operational status. Moreover, at the time of change of the engine operational status from which throttle opening changes or engine rotational speed changes, to change of engine operational status, a real inhalation air content is overdue and changes. Since a criteria inhalation air content is computed in consideration of change of engine operational status based on a basic inhalation air content at this time, a criteria inhalation air content becomes a thing in consideration of the delay of inhalation air. Therefore, both a criteria inhalation air content and a real inhalation air content become a thing including the effect by the delay of inhalation air, and depend the difference of a criteria inhalation air content and a real inhalation air content on an atmospheric pressure difference. Therefore, atmospheric pressure study can be performed with a sufficient precision by measuring a criteria inhalation air content and a real inhalation air content at the time of change of engine operational status.

[0013] The air flow meter which measures the real inhalation air content to which invention according to claim 2 passes through an internal combustion engine's inhalation-of-air path, A calculation means to compute a criteria inhalation air content based on the basic inhalation air content in the criteria atmospheric pressure computed according to the engine operational status containing the opening and engine rotational speed of a throttle valve which were prepared in said inhalation-of-air path, A judgment means by which said engine operational status judges whether it is the back flow generating operational status which the back flow of inhalation air generates, A study means to perform atmospheric pressure study by measuring said criteria inhalation air content and said real inhalation air content, and when it is judged with said engine operational status being back flow generating operational status, When there are more said real inhalation air contents than said criteria inhalation air content, it is characterized by having a prohibition means to forbid the renewal of an increment of the atmospheric pressure correction value by said study means.

[0014] Since the renewal of an increment of atmospheric pressure correction value is forbidden by the

prohibition means when it is judged with it being back flow generating operational status by the judgment means according to the configuration of claim 2, incorrect study of atmospheric pressure study is prevented.
[0015] The air flow meter which measures the real inhalation air content to which invention according to claim 3 passes through an internal combustion engine's inhalation-of-air path, A calculation means to compute a criteria inhalation air content based on the basic inhalation air content in the criteria atmospheric pressure computed according to the engine operational status containing the opening and engine rotational speed of a throttle valve which were prepared in said inhalation-of-air path, In the atmospheric pressure study equipment of the internal combustion engine having a study means to perform atmospheric pressure study by measuring said criteria inhalation air content and said real inhalation air content said calculation means It has a storage means to memorize the air content data set up in the real inhalation air content measured with said air flow meter in the engine operational status of arbitration with said criteria atmospheric pressure. It is characterized by said calculation means computing said basic inhalation air content with reference to said air content data based on the engine operational status at that time.
[0016] According to the configuration of claim 3, a flowed backwards part is contained in the real inhalation air content measured with an air flow meter by back flow generating operational status. Since the air content data for computing a criteria inhalation air content are set up in the real inhalation air content measured in the engine operational status of arbitration with criteria atmospheric pressure, they contain a flowed backwards part in back flow generating operational status. Therefore, even if engine operational status is back flow generating operational status, it will be generated according to an atmospheric pressure difference, and the difference of this criteria inhalation air content and a real inhalation air content can perform atmospheric pressure study with a sufficient precision by measuring a criteria inhalation air content and a real inhalation air content.
[0017] Invention according to claim 4 is characterized by said calculation means computing the criteria inhalation air content which took into consideration change of said engine operational status based on said basic inhalation air content in the atmospheric pressure study equipment of an internal combustion engine given in either claim 2 and claim 3.
[0018] According to the configuration of claim 4, at the time of change of engine operational status, a real inhalation air content is overdue to change of engine operational status, and it changes, but since a criteria inhalation air content is computed in consideration of change of engine operational status based on a basic inhalation air content, a criteria inhalation air content becomes a thing in consideration of the delay of inhalation air. Therefore, both a criteria inhalation air content and a real inhalation air content become a thing including the effect by the delay of inhalation air, and depend the difference of a criteria inhalation air content and a real inhalation air content on an atmospheric pressure difference. Therefore, atmospheric pressure study can be performed with a sufficient precision by measuring a criteria inhalation air content and a real inhalation air content at the time of change of engine operational status.
[0019] It is characterized by invention according to claim 5 performing atmospheric pressure study in the atmospheric pressure study equipment of an internal combustion engine according to claim 1 to 4, when the difference of said criteria inhalation air content and said real inhalation air content of said study means is beyond a predetermined value.
[0020] Since atmospheric pressure study is performed based on a criteria inhalation air content and a real inhalation air content when the difference of the criteria inhalation air content and real inhalation air content which were computed is beyond a predetermined value according to the configuration of claim 5, suitable atmospheric pressure correction value can be acquired the opportunity of atmospheric pressure study not becoming excessive and securing the opportunity of atmospheric pressure study.
[0021]
[Embodiment of the Invention] (The 1st operation gestalt) The 1st operation gestalt which materialized this invention is hereafter explained according to drawing 1 - drawing 3 .
[0022] Drawing 1 shows the outline configuration of the engine system in this operation gestalt. The piston 3 which an engine 1 is equipped with two or more cylinders 2, is constituted, and was prepared in each cylinder 2, respectively can be connected with crankshaft 1a as an output shaft, and can move up and down in each cylinder 2. In each cylinder 2, the piston 3 bottom constitutes a combustion chamber 4.
[0023] The ignition plug 5 prepared corresponding to each of each combustion chamber 4 lights the gaseous mixture introduced into the combustion chamber 4. Each of suction-port 6a prepared corresponding to each combustion chamber 4 and exhaust air port 7a constitutes a part of inhalation-of-air path 6 and flueway 7.
[0024] Each of the intake valve 8 prepared corresponding to each combustion chamber 4 and the exhaust air bulb 9 opens each ports 6a and 7a, respectively. Each of these bulbs 8 and 9 operates based on rotation of

different cam shafts 10 and 11. The timing pulleys 12 and 13 formed at the tip of each cam shafts 10 and 11, respectively are connected with crankshaft 1a through a timing belt 14.
[0025] At the time of operation of an engine 1, the turning effort of crankshaft 1a is transmitted to each cam shafts 10 and 11 through a timing belt 14 and each timing pulleys 12 and 13. When each cam shafts 10 and 11 rotate, each bulbs 8 and 9 operate. Synchronizing with rotation of crankshaft 1a, a compression stroke and explosion / expansion line can synchronize like an exhaust air line, and, as for each bulbs 8 and 9, the inhalation-of-air line according to vertical movement of each piston 3 can operate to predetermined timing.
[0026] The air cleaner 15 formed in the inlet port of the inhalation-of-air path 6 defecates the open air incorporated at this path 6. The injector 16 formed near each suction-port 6a, respectively injects a fuel toward suction-port 6a.
[0027] At the time of operation of an engine 1, the open air is incorporated through an air cleaner 15 at the inhalation-of-air path 6. And in the charging stroke to which an intake valve 8 opens suction-port 6a, when the corresponding injector 16 of a gas column injects a fuel, the gaseous mixture of the fuel and open air which were injected is inhaled in a combustion chamber 4. The gaseous mixture inhaled in the combustion chamber 4 explodes and burns by being lit with an ignition plug 5. Consequently, a piston 3 operates, crankshaft 1a rotates, and an output is obtained by the engine 1. The exhaust air bulb 9 sets like the exhaust air line which opens exhaust air port 7a, and is drawn from a combustion chamber 4, and the exhaust gas after combustion is discharged through a flueway 7 outside.
[0028] Corresponding to actuation of the accelerator pedal which is not illustrated, the closing motion drive of the throttle valve 17 prepared in the inhalation-of-air path 6 is carried out. By adjusting the opening of this throttle valve 17, the effective path area of the inhalation-of-air path 6 through which inhalation air passes is adjusted. The surge tank 18 formed in the downstream of a throttle valve 17 graduates pulsation of inhalation air.
[0029] The intake temperature sensor 19 formed near the air cleaner 15 measures an intake-air temperature tha, and outputs the measurement signal according to the measured value. The throttle sensor 20 formed near the throttle valve 17 measures the opening (throttle opening) ta of this throttle valve 17, and outputs the measurement signal according to the measured value.
[0030] Moreover, the interior is equipped with the heat ray type air flow meter 21 formed in the upstream of a throttle valve 17 by using as a sensing element the metal wire (heat ray) which generates heat by energization. The inhalation air which passes through the inside of this air flow meter 21 outputs this air flow meter 21 as a measurement signal corresponding to the real inhalation air content eklsm which passes through the inside of the inhalation-of-air path 6 the electrical potential difference of the magnitude according to the heating value taken from a sensing element.
[0031] On the other hand, the catalytic converter 22 formed in the middle of the flueway 7 purifies exhaust gas with the built-in three way component catalyst 23. The oxygen sensor 24 formed in the flueway 7 measures the oxygen density Ox in exhaust gas, and outputs the measurement signal according to the measured value. Moreover, the coolant temperature sensor 25 formed in the engine 1 measures the temperature (circulating water temperature) thw of the cooling water for cooling an engine 1, and outputs the measurement signal according to the measured value.
[0032] A distributor 26 distributes the high voltage outputted from an ignitor 27 to each point fire plug 5 as an ignition signal for carrying out ignition actuation of each point fire plug 5. The actuation timing of each point fire plug 5 is determined by the timing to which an ignitor 27 outputs the high voltage.
[0033] Rota (not shown) built in the distributor 26 is rotated by the cam shaft 11 rotated synchronizing with crankshaft 1a. The rotational-speed sensor 28 prepared for the distributor 26 measures the rotational speed (engine speed) ne of an engine 1 based on rotation of Rota, and outputs the measured value as a pulse signal. The gas column distinction sensor 29 prepared for the distributor 26 measures the criteria location of whenever [crank angle] (degreeCA) at a predetermined rate according to rotation of Rota, and, similarly outputs the measured value as a pulse signal. In this operation gestalt, crankshaft 1a rotates two times to a series of about four lines of an engine 1. While crankshaft 1a rotates two times, the rotational-speed sensor 28 outputs the signal of one pulse for every 30-degreeCA. The gas column distinction sensor 29 outputs the signal of one pulse for every 360-degreeCA.
[0034] Moreover, in the equipment of this operation gestalt, the well-known valve timing controlling mechanism 30 is established at the tip of a cam shaft 10 at the timing pulley 12 and one. While pumping up the lubricating oil of the engine 1 currently stored by the oil pan mechanism 31 by the oil pump 32 and supplying it in a device 30 in actuation of the valve timing controlling mechanism 30, the oil pressure is adjusted with the oil control valve 33. Based on the command signal from an electronic control 40, closing

motion control of the oil control valve 33 is carried out.
[0035] The valve timing controlling mechanism 30 equips the interior with the internal-rotation object (illustration abbreviation) formed in a cam shaft 10 and one, while the outline is formed in the timing pulley 12 and one. The valve timing controlling mechanism 30 is an operation of the oil pressure supplied in this device 30, and when the outline and internal-rotation object as external body of revolution carry out relative rotation, it is constituted so that a cam shaft 10 and the timing pulley 12 may carry out relative rotation. The valve timing (control tooth-lead-angle value) vt of an intake valve 8 is changed as a result by the relative rotation between such a cam shaft 10 and the timing pulley 12.
[0036] On the other hand, the valve timing vt of the intake valve 8 changed in this way is detected through the cam sensor 34. That is, the cam sensor 34 formed in the cam shaft 10 measures the actual cam angle (rotation phase) concerning rotation of a cam shaft 10, and outputs the signal according to the measured value.
[0037] In the system shown in this drawing 1 , each sensor output including this cam sensor 34 of the above-mentioned intake temperature sensor 19, the throttle sensor 20, an air flow meter 21, an oxygen sensor 24, a coolant temperature sensor 25, the rotational-speed sensor 28, and the gas column distinction sensor 29 is inputted into an electronic control 40.
[0038] An electronic control 40 is a microcomputer system and recognizes various engine operational status, such as inspired air volume inhaled by the engine 1 based on the output of each [these] sensor, an engine speed, and throttle opening, (detection). And an electronic control 40 performs atmospheric pressure (altitude) study which relates to this invention based on these various operational status in addition to fuel-injection control, ignition timing control, adjustable control of the valve timing of an intake valve 8, etc. The electronic control 40 is equipped with a central processing unit (CPU), a read-only memory (ROM), random access memory (RAM), Backup RAM, etc. ROM stores various control programs and various kinds of maps. The inhalation air content map in the criteria atmospheric pressure used on the occasion of atmospheric pressure study is contained in various maps. CPU performs data processing based on an input signal. RAM memorizes the data in operation / control processing process of CPU. Backup RAM receives supply of power by carrying out direct continuation to a dc-battery (not shown), and since the data (for example, various kinds of study values) with which an ignition switch should be held also in an off condition are stored, it is used.
[0039] Engine control processing of the electronic control 40 performed in the internal combustion engine (engine) which has the above hardware configurations is explained below. Fundamentally, fuel-injection control calculates the injection time by the fuel oil consumption 16, i.e., the injector, which attains a predetermined target air-fuel ratio based on the inhalation air content per rotation of an engine (mass). And when a predetermined crank angle is reached, an injector 16 is controlled that a fuel should be injected. In addition, the inhalation air content per rotation of an engine (mass) is computed from the intake air flow (mass) measured by the heat ray type air flow meter 21, and the engine speed obtained from the rotational-speed sensor 28. And in the case of this fuel-oil-consumption operation, the fundamental amendment based on the signal of the throttle sensor 20, an intake temperature sensor 19, and coolant temperature sensor 25 grade, the air-fuel ratio feedback amendment based on the signal from an oxygen sensor 24, air-fuel ratio study amendment, etc. are added. In addition, it is made for the median of correction value [in / in air-fuel ratio study amendment / air-fuel ratio feedback amendment] to serve as theoretical air fuel ratio.
[0040] Moreover, with the engine speed obtained from the rotational-speed sensor 28, and the signal from other sensors, ignition timing control judges the condition of an engine 1 synthetically, determines the optimal ignition timing, and sends an ignition signal to an ignitor 27.
[0041] In various kinds of control explained above, the amendment based on altitude, i.e., atmospheric pressure, is needed, and atmospheric pressure study for calculating the atmospheric pressure correction value is performed. Also in atmospheric pressure study of this operation gestalt, the criteria inhalation air content in the criteria atmospheric pressure according to the engine operational status at that time is calculated using the inhalation air content map in the criteria atmospheric pressure set up according to engine operational status. And atmospheric pressure correction value is calculated by measuring the criteria inhalation air content in this criteria atmospheric pressure, and the real inhalation air content actually measured with the air flow meter 21.
[0042] Next, the atmospheric-pressure study processing which an electronic control 40 performs is explained according to the flow chart of drawing 2 . The routine shown in this drawing is periodically performed for every predetermined time.
[0043] If processing shifts to this routine, an electronic control 40 will read first the measurement signal

which an air flow meter 21 outputs in step 100, and will detect the real inhalation air content eklsm which passes through the inside of the inhalation-of-air path 6 based on this measurement signal. By the engine operational status which the back flow of inhalation air generates, this real inhalation air content eklsm is restricted to below the upper limit guard value by making the maximum inhalation air content in criteria atmospheric pressure into an upper limit guard value in order to remove a flowed backwards part. In addition, this real inhalation air content eklsm is computed by the load factor (percentage) to the cylinder capacity of a cylinder 2.

[0044] In continuing step 110, while detecting an engine speed ne and the throttle opening ta, valve timing vt is read. An engine speed ne and the throttle opening ta are called for based on the measurement signal outputted from the rotational-speed sensor 28 and the throttle sensor 20, respectively, as mentioned above.

[0045] On the other hand, based on the measurement signal outputted from the rotational-speed sensor 28 and the cam sensor 34, through the special routine which is not illustrated, valve timing vt is the following, and is made and called for.

[0046] That is, the output timing of the pulse signal of the rotational-speed sensor 28 corresponds to whenever [crank angle], and the output timing of the pulse signal of the cam sensor 34 corresponds to a cam angle. Therefore, based on the deflection of both output timing, the phase contrast vt of both include angles, i.e., actual valve timing, is searched for.

[0047] Incidentally, an electronic control 40 determines the valve timing which serves as a target suitably according to the operational status at [that] every engine 1, and it is always performing feedback control so that the actual valve timing vt may be in agreement with this target valve timing. For this reason, the valve timing controlling mechanism 30 drives based on the control command of an electronic control 40, and valve timing vt is always changed.

[0048] At continuing step 120, the basic inhalation air content eklta is computed with reference to the inhalation air content map memorized by said ROM based on engine-speed ne, the throttle opening ta, and valve timing vt for which it asked at previous step 110. This inhalation air content map is set up based on the real inhalation air content eklsm measured with the air flow meter 21 in criteria atmospheric pressure by the stable state of engine operational status, such as engine-speed ne, the throttle opening ta, and valve timing vt. The value as which the basic inhalation air content eklta in the engine operational status which a back flow generates in this inhalation air content map considered correction value [in / to the upper limit guard value of the real inhalation air content eklsm / Air Fuel Ratio Control] is set up. In addition, the basic inhalation air content eklta of this inhalation air content map is set up by the load factor (percentage) to the cylinder capacity of a cylinder 2.

[0049] At the following step 130, the criteria inhalation air content eklcrt which took change of engine operational status into consideration based on the basic inhalation air content eklta computed at previous step 120 is computed. As this shows drawing 3 , at the time of change of engine operational status, the inhalation air of the inhalation-of-air path 6 is overdue to the change, it changes, and the effect by delay is included in the real inhalation air content eklsm. The basic inhalation air content eklta is an air content in the stable state of engine operational status. Therefore, the difference of the basic inhalation air content eklta and the real inhalation air content eklsm which were computed based on the engine operational status at that time becomes what included the effect by the delay of inhalation air in addition to the atmospheric pressure difference. On the other hand, the criteria inhalation air content eklcrt computed in consideration of change of engine operational status based on the basic inhalation air content eklta becomes a thing in consideration of the effect of the delay of inhalation air. Therefore, both the criteria inhalation air content eklcrt and the real inhalation air content eklsm become a thing including the effect by the delay of inhalation air, and depend mostly the difference of the criteria inhalation air content eklcrt and the real inhalation air content eklsm on an atmospheric pressure difference. Incidentally in this operation gestalt, the criteria inhalation air content eklcrt is computed by the following formulas (1).

[0050]

[Equation 1]

$$eklcrt(i) = eklcrt(i-1) + \{eklta + eklcrt(i-1)\} / delta \quad -- (1)$$

In addition, as delta in a formula (1), the proper value according to the inhalation-of-air engine performance of an engine 1 can be set up, for example, 32 and 64 grades can be set up as delta.

[0051] step 140 -- said criteria inhalation air content eklcrt to said real inhalation air content eklsm -- subtracting -- difference -- tdlkltn is computed. the difference for which it asked at previous step 140 in step 150 -- tdlkltn judges whether it is under -alpha%. alpha is a positive number and is set as alpha= 4 in this case. difference -- if judged with tdlkltn being under -alpha% -- step 160 -- progressing -- difference -- if

judged with tdlkltn being more than -alpha%, it will progress to step 180.
[0052] At step 160, it is judged based on engine-speed ne calculated at said step 110, the throttle opening ta, and valve timing vt whether it is back flow generating operational status. If judged with back flow generating operational status at this step 160, it may incorrect-learn in the direction in which the real inhalation air content eklsm restricted to the upper limit guard value becomes a big value, and increases atmospheric pressure correction value from the criteria inhalation air content eklcrt. Therefore, atmospheric pressure study is not performed but this processing is ended. Moreover, if judged with it not being back flow generating operational status reverse at step 160, it will progress to step 170.
[0053] By adding a predetermined value (0.001 [in this case]) to current atmospheric pressure correction value in step 170, the atmospheric pressure correction value ekpa is updated and this processing is ended.
[0054] moreover, the difference for which it asked at previous step 140 in step 180 -- it judges whether tdlkltn is larger than alpha%. difference -- if judged with tdlkltn being below alpha%, atmospheric pressure study will not be performed but this processing will be ended. difference -- if judged with tdlkltn being larger than alpha%, it will progress to step 190.
[0055] By subtracting a predetermined value (0.001 [in this case]) from current atmospheric pressure correction value in step 190, the atmospheric pressure correction value ekpa is updated and this processing is ended. And the atmospheric-pressure correction value ekpa computed at the atmospheric-pressure correction value ekpa computed at step 170 or step 190 will be memorized by Backup RAM, and will be used as a numeric value which amends a fuel-injection controlled variable etc.
[0056] According to the atmospheric pressure study equipment of this operation gestalt explained in full detail above, the following effectiveness can be acquired. - It faces performing atmospheric pressure study and the basic inhalation air content eklta in criteria atmospheric pressure is computed with reference to an inhalation air content map based on engine operational status. Since the criteria inhalation air content eklcrt which took change of engine operational status into consideration based on this basic inhalation air content eklta is computed, the criteria inhalation air content eklcrt becomes a thing in consideration of the effect of the delay of inhalation air. Therefore, both the criteria inhalation air content eklcrt and the real inhalation air content eklsm become a thing including the effect by the delay of inhalation air, and depend mostly the difference of the criteria inhalation air content eklcrt and the real inhalation air content eklsm on an atmospheric pressure difference. Therefore, of course, exact atmospheric pressure correction value can be computed now by the stable state of engine operational status at the time of change of engine operational status by measuring the criteria inhalation air content eklcrt and the real inhalation air content eklsm.
[0057] - Since the renewal of an increment of atmospheric pressure correction value is forbidden when it faces performing atmospheric pressure study and it is judged with back flow generating operational status, and there are more real inhalation air contents eklsm than the criteria inhalation air content eklcrt, incorrect study of atmospheric pressure study can be prevented suitably.
[0058] - the difference of the criteria inhalation air content eklcrt and the real inhalation air content eklsm by which the electronic control 40 was computed based on engine operational status -- when tdlkltn is under -alpha%, or when larger than alpha%, it is made to perform atmospheric pressure study. Therefore, suitable atmospheric pressure correction value can be acquired, the opportunity of atmospheric pressure study not becoming excessive and securing the opportunity of atmospheric pressure study suitably.
[0059] (The 2nd operation gestalt) Next, the 2nd operation gestalt of this invention is explained according to drawing 4 . In the above-mentioned 1st operation gestalt, when an internal combustion engine was back flow generating operational status, and there were more real inhalation air contents eklsm than the criteria inhalation air content eklcrt, the renewal of an increment of atmospheric pressure correction value is forbidden, and incorrect study was prevented. Thus, if the renewal of an increment of atmospheric pressure correction value is forbidden, the opportunity of incorrect study of atmospheric pressure study of atmospheric pressure study of what can be prevented will decrease.
[0060] Then, it permits that a flowed backwards part of inhalation air is included as a real inhalation air content and a criteria inhalation air content, even if it is back flow generating operational status, atmospheric pressure study is performed, and it enables it to perform updating by the side of the increment in atmospheric pressure correction value with this operation gestalt.
[0061] In this operation gestalt, the engine structure of a system is the same as that of the 1st operation gestalt. It explains according to the flow chart which shows the atmospheric-pressure study processing which an electronic control 40 performs in this operation gestalt to drawing 4 . This processing is processing which is set up beforehand and which is periodically performed repeatedly for every short time.
[0062] If processing shifts to this routine, an electronic control 40 will read first the measurement signal

which an air flow meter 21 outputs in step 200, and will detect the real inhalation air content eklsma which passes through the inside of the inhalation-of-air path 6 based on this measurement signal. This real inhalation air content eklsma is a value which does not remove a flowed backwards part in back flow generating operational status. In addition, this real inhalation air content eklsma is computed by the load factor (percentage) to the cylinder capacity of a cylinder 2.

[0063] In continuing step 210, while detecting an engine speed ne and the throttle opening ta like the above-mentioned 1st operation gestalt, valve timing vt is read.

[0064] At continuing step 220, the basic inhalation air content ekltaa is computed with reference to the inhalation air content map memorized by said ROM based on engine-speed ne, the throttle opening ta, and valve timing vt for which it asked at previous step 210. This inhalation air content map is set up based on the real inhalation air content eklsma measured with the air flow meter 21 in criteria atmospheric pressure by the stable state of engine operational status, such as engine-speed ne, the throttle opening ta, and valve timing vt. The real inhalation air content eklsma is set up as a basic inhalation air content ekltaa in the engine operational status which a back flow generates in this inhalation air content map. In addition, the basic inhalation air content ekltaa of this inhalation air content map is set up by the load factor (percentage) to the cylinder capacity of a cylinder 2.

[0065] At the following step 230, the criteria inhalation air content eklcrta which took change of engine operational status into consideration based on the basic inhalation air content ekltaa computed at previous step 220 is computed. As this shows drawing 3 , at the time of change of engine operational status, the inhalation air of the inhalation-of-air path 6 is overdue to the change, it changes, and the effect by delay is included in the real inhalation air content eklsma. The criteria inhalation air content eklcrta computed in consideration of change of engine operational status based on the basic inhalation air content ekltaa becomes a thing in consideration of the effect of the delay of inhalation air. Therefore, both the criteria inhalation air content eklcrta and the real inhalation air content eklsma become a thing including the effect by the delay of inhalation air, and depend mostly the difference of the criteria inhalation air content eklcrta and the real inhalation air content eklsma on an atmospheric pressure difference. Incidentally in this operation gestalt, the criteria inhalation air content eklcrta is computed by the following formulas (2).

[0066]

[Equation 2]

eklcrta (i) =eklcrta (i-1) + {ekltaa+eklcrta (i-1)} /delta -- (2)

In addition, as delta in a formula (2), the proper value according to the inhalation-of-air engine performance of an engine 1 can be set up, for example, 32 and 64 grades can be set up as delta.

[0067] step 240 -- said criteria inhalation air content eklcrta to said real inhalation air content eklsma -- subtracting -- difference -- tdlkltn is computed. the difference for which it asked at previous step 240 in step 250 -- tdlkltn judges whether it is under -alpha%. alpha is a positive number and is set as alpha= 4 in this case. difference -- if judged with tdlkltn being under -alpha% -- step 260 -- progressing -- difference -- if judged with tdlkltn being more than -alpha%, it will progress to step 270.

[0068] By adding a predetermined value (0.001 [in this case]) to current atmospheric pressure correction value in step 260, the atmospheric pressure correction value ekpa is updated and this processing is ended.

[0069] moreover, the difference for which it asked at previous step 240 in step 270 -- it judges whether tdlkltn is larger than alpha%. difference -- if judged with tdlkltn being below alpha%, atmospheric pressure study will not be performed but this processing will be ended. difference -- if judged with tdlkltn being larger than alpha%, it will progress to step 280.

[0070] By subtracting a predetermined value (0.001 [in this case]) from current atmospheric pressure correction value in step 280, the atmospheric pressure correction value ekpa is updated and this processing is ended. And the atmospheric-pressure correction value ekpa computed at the atmospheric-pressure correction value ekpa computed at step 260 or step 280 will be memorized by Backup RAM, and will be used as a numeric value which amends a fuel-injection controlled variable etc.

[0071] Therefore, according to this operation gestalt, in addition to the effectiveness of said 1st operation gestalt, the following effectiveness can be acquired. - It faces performing atmospheric pressure study, and the real inhalation air content eklsma of an air flow meter 21 is permitted and set [that a flowed backwards part is included and] up. Moreover, the basic inhalation air content ekltaa in the criteria atmospheric pressure computed with reference to an inhalation air content map based on engine operational status is permitted and computed [that a flowed backwards part is included and]. Therefore, both the criteria inhalation air content eklcrta and the real inhalation air content eklsma become a thing containing a flowed backwards part, and depend mostly the difference of the criteria inhalation air content eklcrta and the real

inhalation air content eklsma on an atmospheric pressure difference. Therefore, by measuring the criteria inhalation air content eklcrta and the real inhalation air content eklsma, even if it is back flow generating operational status, exact atmospheric pressure correction value can be computed, and updating by the side of the increment in atmospheric pressure correction value and reduction can be performed.

[0072] - The real inhalation air content eklsma and the criteria inhalation air content eklcrta (basic inhalation air content ekltaa) are permitted and set [that a flowed backwards part is included and] up again. Therefore, it is not necessary to judge whether it is back flow generating operational status like step 160 of the 1st operation gestalt, and atmospheric pressure study processing can be simplified.

[0073] In addition, the gestalt of operation is not limited above and may be changed as follows. - the difference for performing atmospheric pressure study with each above-mentioned operation gestalt -- although the predetermined value alpha for judging tdlkltn was set to 4, you may make it change the value of alpha suitably according to the inhalation-of-air engine performance based on the model of engine 1 Even in this case, the same operation and effectiveness as each above-mentioned operation gestalt can be acquired.

[0074] - In the 1st operation gestalt, step 130 is skipped by making the basic inhalation air content eklta into a criteria inhalation air content. and the thing for which the real inhalation air content eklsm is subtracted from the basic inhalation air content eklta at continuing step 140 -- difference -- you may make it calculate tdlkltn In this case, the incorrect study by the side of the increment in the atmospheric pressure correction value in back flow generating operational status can be prevented suitably.

[0075] - In the 2nd operation gestalt, step 230 is skipped by making the basic inhalation air content ekltaa into a criteria inhalation air content. and the thing for which the real inhalation air content eklsma is subtracted from the basic inhalation air content ekltaa at continuing step 240 -- difference -- you may make it calculate tdlkltn In this case, the incorrect study by the side of the increment in the atmospheric pressure correction value in back flow generating operational status can be prevented suitably.

[0076] - Although each above-mentioned operation gestalt carried out the gasoline in the engine used as a fuel, it may be carried out in the engine which uses LPG as a fuel. Next, other technical thought which can be grasped from each above-mentioned operation gestalt is indicated below.

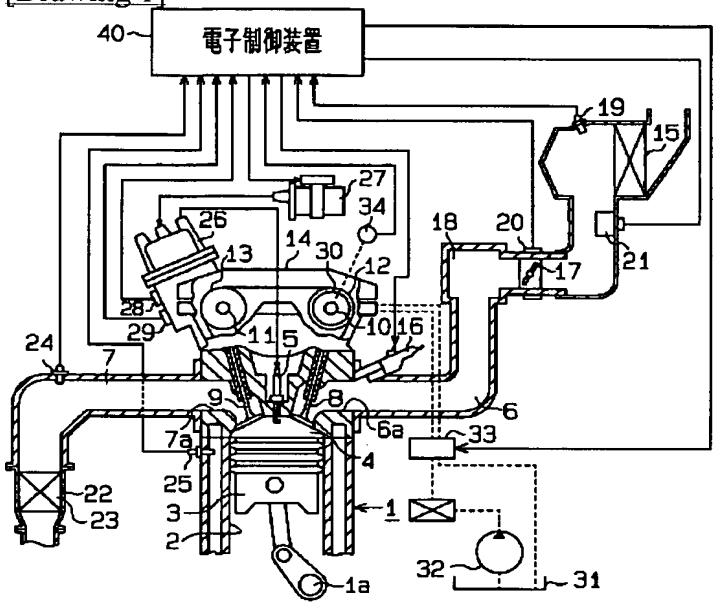
[0077] - It is atmospheric pressure study equipment of the internal combustion engine with which inhalation air to which said air flow meter passes through said inhalation-of-air path in the atmospheric pressure study equipment of an internal combustion engine according to claim 1 to 5 is characterized by being the heat type air flow meter which outputs the heating value taken from a sensing element as a measurement signal about the flow rate of said inhalation air.

[Translation done.]

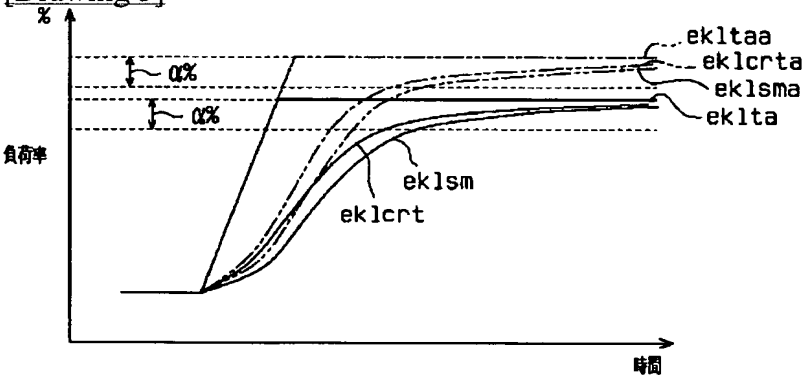
* NOTICES *

DRAWINGS

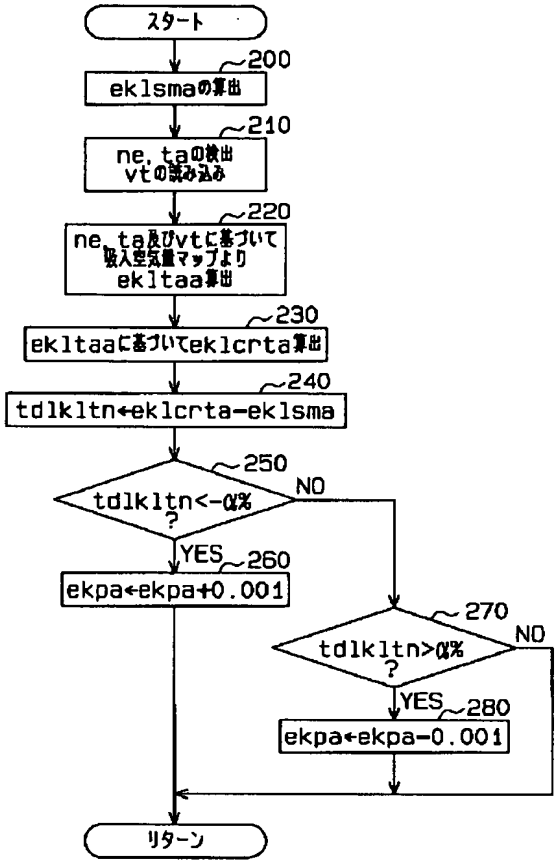
[Drawing 1]



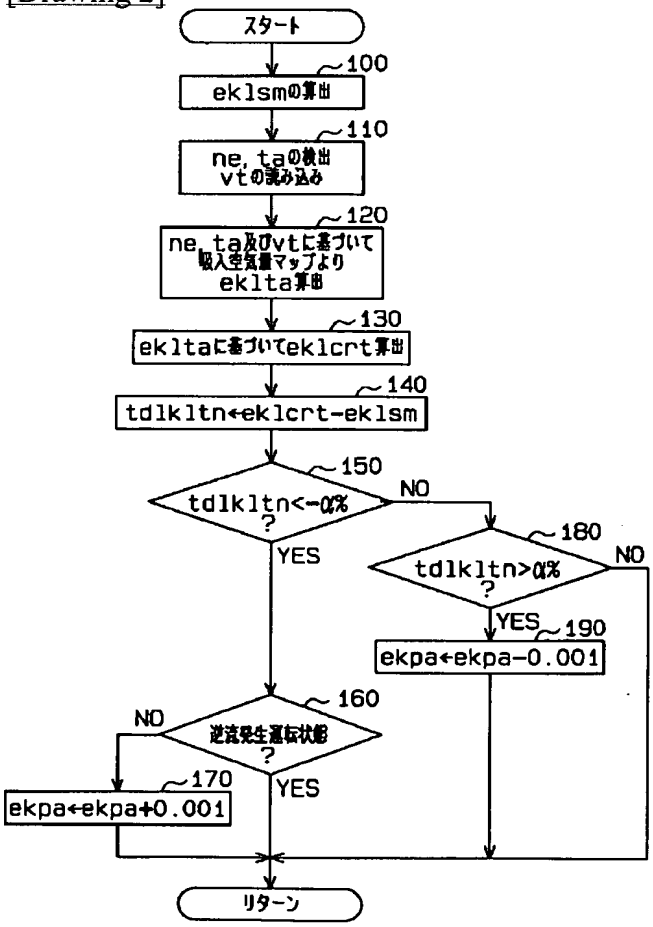
[Drawing 3]



[Drawing 4]


スタート
200
eklsmaの算出
210
ne, taの検出
vtの読み込み
220
ne, ta及びvtに基づいて
吸入空気量マップより
ekltaa算出
230
ekltaaに基づいてeklcrta算出
240
tdlkltn←eklcrta-eklsma
250
tdlkltn<-α%
?
NO
YES
260
ekpa←ekpa+0.001
270
tdlkltn>α%
?
NO
YES
280
ekpa←ekpa-0.001
リターン

[Drawing 2]


スタート
100
eklsmの算出
110
ne, taの検出
vtの読み込み
120
ne, ta及びvtに基づいて
吸入空気量マップより
eklta算出
130
ekltaに基づいてeklcrt算出
140
tdlkltn←eklcrt-eklsm
150
tdlkltn<-α%
?
NO
YES
180
tdlkltn>α%
?
NO
YES
190
ekpa←ekpa-0.001
160
逆流発生運転状態
?
NO
YES
170
ekpa←ekpa+0.001
リターン

[Translation done.]